African Invertebrates 62(1): 257–271 (2021)
doi: 10.3897/AfrInvertebr.62.58842
https://africaninvertebrates.pensoft.net

RESEARCH ARTICLE

African Invertebrates
A journal of biodiversity research

The first record of *Omosita nearctica* Kirejtshuk (Coleoptera, Nitidulidae) in South Africa, with the first description of its mature larva

Kirstin A. Williams[1,2], Crystal-Leigh Clitheroe[2,3], Martin H. Villet[2], John M. Midgley[1,2]

1 *Department of Natural Sciences, KwaZulu-Natal Museum, 237 Jabu Ndlovu Street, Pietermaritzburg, South Africa* **2** *Southern African Forensic Entomology Research Laboratory, Rhodes University, PO Box 94, Makhanda, South Africa* **3** *Current address: Evolutionary Genomics – Bourguignon Unit, Okinawa Institute of Science and Technology, Okinawa, Japan*

Corresponding author: Kirstin A. Williams (kwilliams@nmsa.org.za)

Academic editor: B. Muller | Received 21 September 2020 | Accepted 10 February 2021 | Published 25 February 2021

http://zoobank.org/9B329DDF-9C38-43FC-943F-AFAC4742FFFF

Citation: Williams KA, Clitheroe C-L, Villet MH, Midgley JM (2021) The first record of *Omosita nearctica* Kirejtshuk (Coleoptera, Nitidulidae) in South Africa, with the first description of its mature larva. African Invertebrates 62(1): 257–271. https://doi.org/10.3897/AfrInvertebr.62.58842

Abstract

Sap beetles of the genus *Omosita* Erichson are stored-product pests that are also associated with carrion, potentially making them biosecurity risks and forensic tools. The discovery of a specimen of the Nearctic species *Omosita nearctica* Kirejtshuk in South Africa prompted an investigation a decade later to determine if this species had established itself in the country, which was confirmed by the collection of further breeding specimens that also facilitated the first description of mature larvae of *O. nearctica*. A new key to adults of all *Omosita* species is presented.

Keywords

Biosecurity, forensic entomology, invasion biology, larval morphology, molecular identification, morphological key

Copyright *Kirstin A. Williams et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Introduction

Many insects associated with stored products have been moved between continents following humans' colonisation of new places. In the case of cryptogenic species, this invasion process has been so thorough that the geographical origin of the insect invaders is no longer clear, e.g. the Hide Beetle, *Dermestes maculatus* DeGeer, 1774 (Coleoptera: Dermestidae) (Mroczkowski 1968). In other cases, these invasive species are not noticed for years even though they may be well-known pests in other countries, e.g. the Oriental Latrine Fly, *Chrysomya megacephala* (Fabricius, 1794) (Diptera: Calliphoridae) in South Africa (Williams and Villet 2006; Badenhorst and Villet 2018). Insects, and particularly beetles (Midgley et al. 2009), associated with stored animal products, are often of significance in forensic entomology and biosecurity, and keeping track of new members of the carrion insect community in a particular country is important in both of these contexts.

The sap beetle family Nitidulidae has approximately 350 genera and over 4500 species (Lee et al. 2020). The Nitidulidae in Africa have not been well studied and so what is known of them is limited (Kirejtshuk 2001). There are seven recognised species in the genus *Omosita* Erichson, 1843 – O. *discoidea*, *O. colon*, *O. depressa*, *O. funesta*, *O. smetanai*, *O. japonica* and *O. nearctica* (Reitter 1873, 1874; Kirejtshuk 1987; Lee et al. 2015). A specimen of *O. discoidea* in the Naturhistoriska Riksmuseet, Stockholm*, was collected by Gustav de Vylder (Lee et al. 2015), probably during his stays in Cape Town in 1871–1873 and 1879–1885 (de Vylder 1998); no other published records of *Omosita* in the Afrotropical Region were found.

At least some sap beetles of the genus *Omosita* are relevant in forensic entomological and biosecurity contexts because they are occasional pests of stored products and can be abundant on carrion and corpses (Hinton 1945; Shubeck et al. 1977; Jelínek 1999; Kočárek 2003; Ewing and Cline 2005; Schlechter 2008; Saloña et al. 2010; Lee et al. 2015; Lyu et al. 2016; Torres et al. 2018; Lee et al. 2020). Several *Omosita* species have been translocated around the globe, e.g. the Palaearctic species *Omosita colon* (Linnaeus, 1758) and *Omosita discoidea* (Fabricius, 1775) have been reported from Australia and New Zealand (Blackburn 1903; Carlton and Leschen 2007); *O. colon* has been recorded on Pitt Island, 800 km east of New Zealand (Alfken 1904; Emberson 1998); and the Mexican species *Omosita funesta* Reitter, 1873 is reported from Spain (Audisio 1990). Despite their applied significance and widespread distribution, literature about the distribution of *Omosita* species is demonstrably scattered.

Omosita nearctica Kirejtshuk, 1987 was described from North America (Kirejtshuk 1987), but nothing has yet been published about its biology. Some North American records of *O. colon* published or identified before 1987 may actually represent *O. nearctica*, which was only recognised as a separate species in that year (Kirejtshuk 1987).

---

* The report of a specimen in the Natural History Museum, London (Lee et al. 2015) is a *lapsus calami* (Kirejtshuk, pers. comm.).

The collection of a single specimen of *Omosita nearctica* in August 2001 in South Africa suggested the introduction of *O. nearctica* to this country. This paper reports this discovery, confirms the breeding of *O. nearctica* in South Africa, and provides the first description of its larva.

Materials and methods

Specimen collection

An adult specimen of *Omosita nearctica* was collected in a trap baited with 50 g of fresh chicken liver in Makhanda (formerly Grahamstown), Eastern Cape province, South Africa, in August 2001, during a study of the seasonal distribution of forensically important flies (Villet et al. 2017; Williams and Villet 2019). The specimen was discovered in 2012 among the ethanol-preserved flies. It was mounted and deposited in the Albany Museum, Makhanda, South Africa (specimen number AM 66416[**]).

Cooked sheep shank bones were placed in custom-made traps hung about 50 cm above ground in trees at municipal rubbish dumps (or landfills) in Makhanda (33.291°S, 26.492°E) in February 2012 and 2013, and nearby Port Alfred (33.568°S, 26.879°E) in February 2013. The traps were checked regularly and when beetles were caught, they were taken back to Rhodes University and caged with uncooked beef shin bones. Larvae were discovered feeding on the fatty bones in March 2013. The adults (unsexed) and larvae were preserved in 96% ethanol. Five larval specimens were deposited in the wet collection of the KwaZulu-Natal Museum, Pietermaritzburg, South Africa (specimen number NMSA-COL 1405–1409). Adult specimens were card mounted and two specimens were deposited in the KwaZulu-Natal Museum (specimen number NMSA-COL 1898 and NMSA-COL 1410), two in the South African National Collection of Insects, Pretoria, South Africa (accession number SANC-COLG-00021) and two in the Albany Museum, Makhanda, South Africa (specimen numbers AM 101483 and AM 101484).

Identification

The adult beetles (n = 28) were identified from their morphology using the keys in Jelínek (1999) and Lee et al. (2015) and the description and illustrations in Kirejtshuk (1987). A new diagnostic key to the adults of the seven accepted species of *Omosita* is presented in Appendix 1.

One hind leg of a single beetle (NMSA-COL 1898) was used for DNA analysis. DNA was extracted using the Qiagen DNeasy tissue kit (Qiagen, Inc., Valencia, CA)

** This specimen is misidentified on the Global Biodiversity Information Facility (GBIF) as *Omosita japonica* (Gess and Ranwashe 2017).

according to the manufacturer's instructions. A portion of the cytochrome oxidase I (COI) gene was sequenced using the LCO1490 forward (5'-GGTCAACAAAT-CATAAAGATATTGG-3') and HCO2198 reverse (5'-TAAACTTCAGGGTGAC-CAAAAAAT-3') primers. Polymerase chain reaction (PCR) amplification was conducted and the PCR product was sequenced by Macrogen Inc, Seoul, South Korea (https://dna.macrogen-europe.com/). The COI sequence was run through the Basic Local Alignment Search Tool (BLAST – https://blast.ncbi.nlm.nih.gov) to confirm the morphological identification.

To facilitate comparative biology, a molecular phylogeny of four of the seven species of *Omosita* was estimated. Additional COI sequences of the four widespread *Omosita* species were downloaded from the Barcode of Life Data System v4 (BOLD) (Table 1) and analysed together with the new sequence. *Brachypeplus glaber* LeConte (Nitidulidae: Cillaeinae) and two species of *Nitidula* Fabricius (Nitidulidae: Nitidulinae) were used as outgroups. Bayesian inference analyses were performed with MrBayes (Huelsenbeck and Ronquist 2001) using the best-fitting nucleotide substitution mode (GTR+G) from jModelTest (Posada 2008). One cold and three hot chains were run for 5 000 000 generations, sampling every 1 000 generations with burn-in of 1 000 samples (20%).

Larval morphology

Three mature larvae were prepared for scanning electron microscopy (SEM) by critical-point drying and sputter-coating with gold (NMSA-COL 1402). The specimens were viewed with a Zeiss Evo LS 15 SEM at the University of KwaZulu-Natal's Microscopy and Microanalysis Unit, Pietermaritzburg, South Africa. Two mature larvae were slide mounted using standard protocols and viewed using a Leica compound microscope (NMSA-COL 1403 and 1404). A further five mature larvae were examined using a Leica dissecting microscope (NMSA-COL 1405–1409). Measurements were taken using a graduated eye-piece.

Results

Morphological identification

Twenty-eight adult specimens of *Omosita* were collected in Makhanda (1 in 2001, 12 in February 2012 and 15 in February 2013) but none in Port Alfred. The beetles keyed out as *Omosita colon* using the keys to Palaearctic species of *Omosita* presented by Jelínek (1999) and Lee et al. (2015), but these keys necessarily do not include *O. nearctica*, which is as yet unknown from the Palaearctic. Kirejtshuk (1987) compared his newly described *O. nearctica* with *O. colon* and his description and figures confirmed that our specimens were *O. nearctica*.

Table 1. Sequences from NCBI GenBank and BOLD used in the Bayesian inference analysis. New sequences are set in bold typeface.

Species	Location	GenBank accession number	BOLD Sequence ID
Omosita colon	Athenstedt, Germany	KU907100	GCOL10982-16.COI-5P
	Athenstedt, Germany	KU910800	GCOL10988-16.COI-5P
	Edenkoben-Rhodt, Villa Ludwigshoehe, Germany	KM441201	FBCOO036-13.COI-5P
	Haembach, Haembacher Teich, Halde, Germany	KU913847	GCOL5018-16.COI-5P
	Hailiniemi, Finland	KJ965999	COLFE1417-13.COI-5P
	Hailiniemi, Finland	KJ966608	COLFE1416-13.COI-5P
	Kallvik, Helsinki, Finland	KJ965633	COLFD167-12.COI-5P
	Kallvik, Helsinki, Finland	KJ967401	COLFD168-12.COI-5P
	Lauttasaari, Finland	KJ965605	COLFE421-12.COI-5P
	Nobitz-Klausa, Leinawald, Germany	KM446224	GBCOL020-12.COI-5P
	Wesel-Diersfordt, Diersfordter Wald Gatter, Germany	KM452483	FBCOC604-10.COI-5P
Omosita depressa	Arnsberg-Breitenbruch, NWZ Hellerberg, Germany	KM442498	FBCOH678-12.COI-5P
	Bornheim-Hemmerich, Ortslage, Germany	KM446940	FBCOG1013-12.COI-5P
	Nobitz-Klausa, Leinawald, Germany	KM449233	GBCOC743-12.COI-5P
	Oberheimbach, Franzosenkopf, Germany	KM439454	GBCOE444-13.COI-5P
Omosita discoidea	Bornheim-Hemmerich, Ortslage, Germany	KU919455	GCOL7562-16.COI-5P
	Langenthal, Germany	KU912774	GCOL9483-16.COI-5P
	Rowe Tamarack Trail, Canada	KM849291	SSWLC101-13.COI-5P
	Saalealtarm, Germany	KU909461	GCOL9547-16.COI-5P
	Schaidt, NWR Stuttpferch, Germany	KM445991	FBCOE490-12.COI-5P
	Staerkerwald, Germany	KU916825	GCOL7701-16.COI-5P
	Wandersleben, Burg Gleichen, Germany	KU919608	GCOL9399-16.COI-5P
Omosita nearctica	Charitable Research Reserve, Canada	MG054067	RRSSC3383-15.COI-5P
Omosita nearctica	**Makhanda (previously Grahamstown), South Africa**	**MT371766**	–
Omosita nearctica[a]	Puslinch, Canada	MG058703	COLON045-10.COI-5P
Omosita nearctica	Sable Island National Park Reserve, Canada	KR916043	CNSIB573-15.COI-5P
Omosita sp.	Kawartha Lakes, Canada	–	BARSL067-16.COI-5P
Outgroups			
Brachypeplus glaber	United States of America	KC491232	GBCL15295-13.COI-5P
Nitidula bipunctata	Rana u Loun, Oblik, Czech Republic	KM452114	GBCOU1431-13.COI-5P
	Langenthal, Germany	KU909854	GCOL9484-16.COI-5P
	Wandersleben, Burg Gleichen, Germany	KU908969	GCOL9400-16.COI-5P
		KU918404	GCOL9401-16.COI-5P
Nitidula rufipes	Hailiniemi, Finland	KJ962313	COLFE1409-13.COI-5P
		KJ965428	COLFE1410-13.COI-5P
		KJ963473	COLFE1411-13.COI-5P
		KJ964776	COLFE1412-13.COI-5P
	Rana u Loun, Oblik, Czech Republic	KM440272	GBCOU1469-13.COI-5P
		KM443376	GBCOU1470-13.COI-5P
		KM441409	GBCOU1861-13.COI-5P
		KU915079	GCOL6778-16.COI-5P

[a] Misidentification (see Fig. 2).

Molecular identification

The partial COI sequence from one specimen (Genbank accession number: MT371766, NMSA-COL 1898) was 656 bp long and aligned easily with the other sequences. It had a 100% BLAST match to *O. nearctica*, with the highest match to *O. colon* at 89.31% (Table 2). In the Bayesian inference tree (Fig. 2), the new sequence forms a clade exclusively containing other *O. nearctica* sequences.

Table 2. BLAST metrics of similarity for *Omosita nearctica* sequence from Makhanda, South Africa.

Species	% Coverage	% Match	E-value
Omosita nearctica	100%	100%	0.0
Omosita colon	99%	89.3%	0.0
Omosita discoidea	99%	88.21%	0.0
Omosita depressa	–	No significant similarity	
Nitidula rufipes	100%	87.82%	0.0
Nitidula bipunctata	–	No significant similarity	

Taxonomy

Diagnosis of adult

Body length 2.4–3.7 mm, oblong ovate, sparsely pubescent, testaceous except for piceous markings on anterior half of elytra, and pale markings on lateral pronotal margins and posterior half of elytra; antennal club not longer than wide; pronotum transverse, concave anteriorly and arcuate laterally, with sides converging more apically than basally, with two oval depressions before scutellum; elytra jointly at least 0.75 as wide as their length, their apices obliquely rounded, forming a common arc and usually exposing one abdominal tergite (Fig. 1). The phallobase is subparallel, with the parameres fused and not divergent; the tegmen is anteriorly transverse and shallowly excavate apically.

Omosita colon differs most notably from *O. nearctica* in the shape of the antennal club which is elongate-oval, much longer than wide and its body shape which is oval. *Omosita discoidea* differs from *O. nearctica* in the pronotum colour which is black in the centre and testaceous towards the edges and the antennal club which is longer than wide (Kirejtshuk 1987; Lee et al. 2015)

Description of mature larva

Measurements. Body length 4 mm. Head capsule 0.5 mm wide.

Body (Fig. 3). Body campodeiform; subdepressed; widest in abdominal region; white or yellow; uniformly pigmented; poorly sclerotised. Head and all terga with scattered setae; body setae with apices entire.

Head (Figs 4–6). Head capsule (Fig. 4) 2.3 times as wide as long (excluding the labrum); trapezoidal, tapered towards mouthparts; lateral margins straight, at most gently convex; dorsal hind margin slightly retracted; ventral hind margin strongly retracted; granular or tuberculate; with one dorsal and no ventral stemma on each side. Antenna with three antennomeres. Basal antennomere almost as long as wide; without setae. Second antennomere as long as or slightly longer than first; with mesal, subapical sensory area bearing a large cone; with sensory appendix about two thirds the length of third antennomere; with setae, including one directly proximal to sensory area. Third antennomere about as long as basal antennomere; setose with a group of minute apical setae. Frontal sutures impressed, reaching near antennal insertions; frontoclypeal suture distinct laterally, obsolete medially. Clypeus trap-

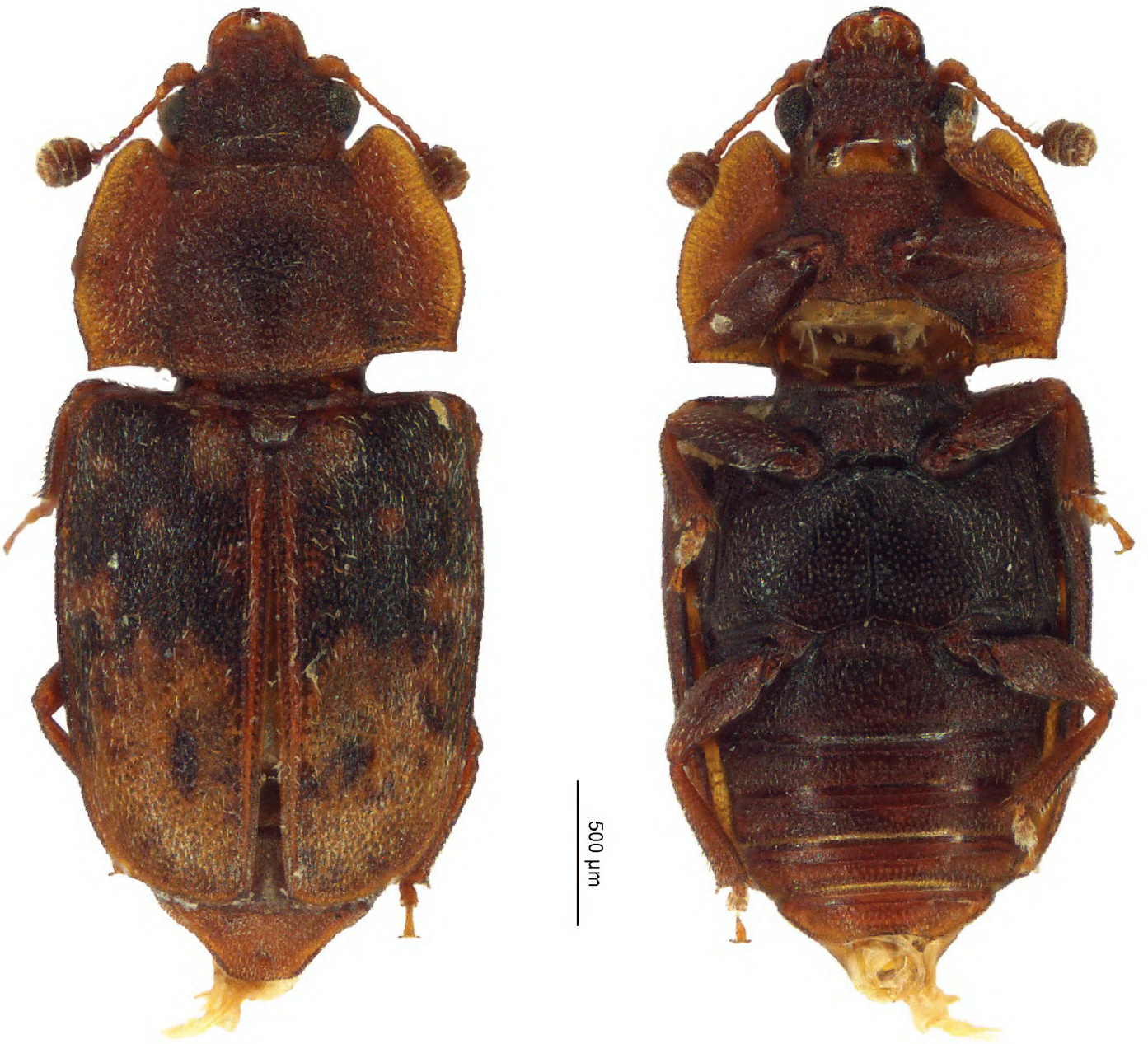


Figure 1. *Omosita nearctica* adult, dorsal and ventral view, captured in February 2013 in Makhanda, South Africa. Scale bar: 0.5 mm.

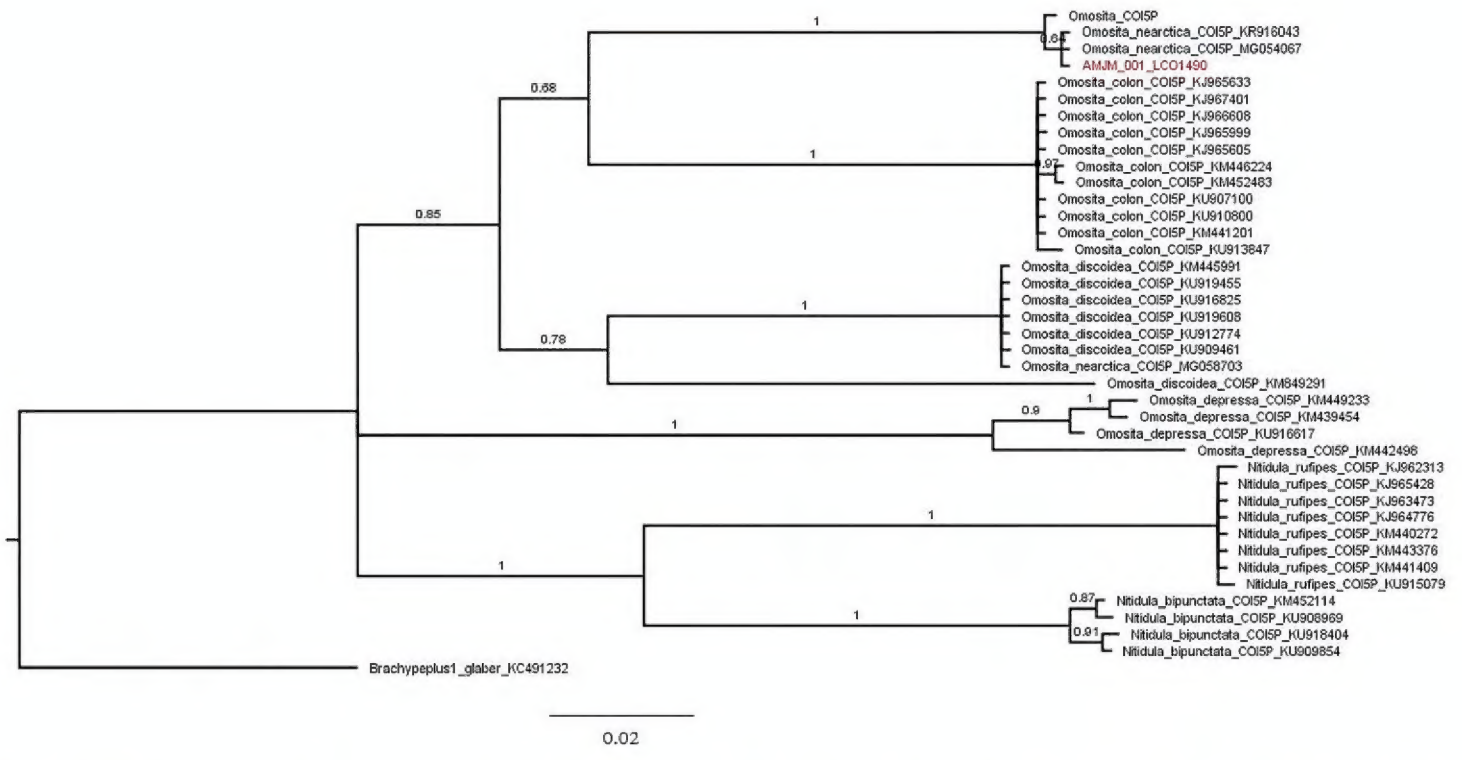


Figure 2. Bayesian inference tree of COI sequences. Posterior probability values are shown on branches. Red text is the South African sequence generated in this study.

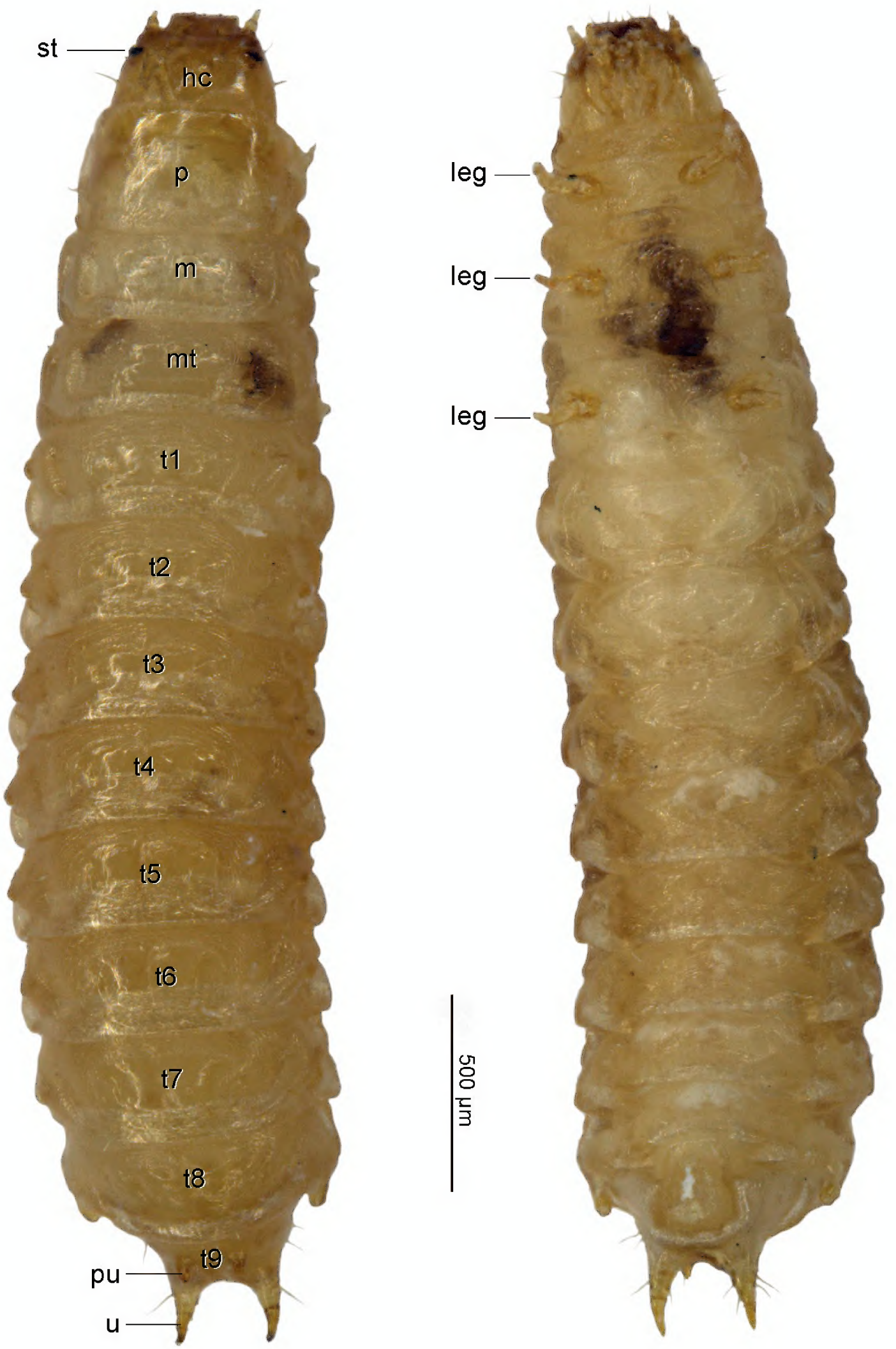
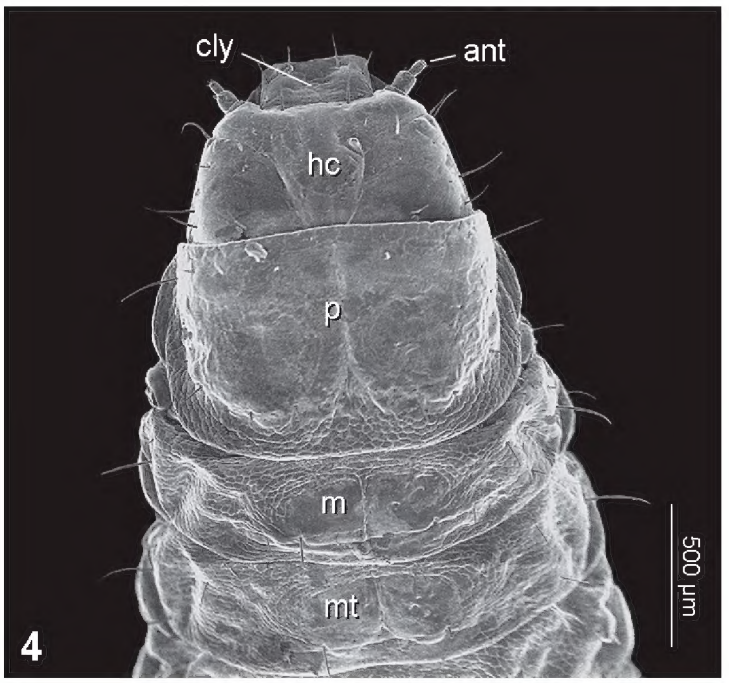
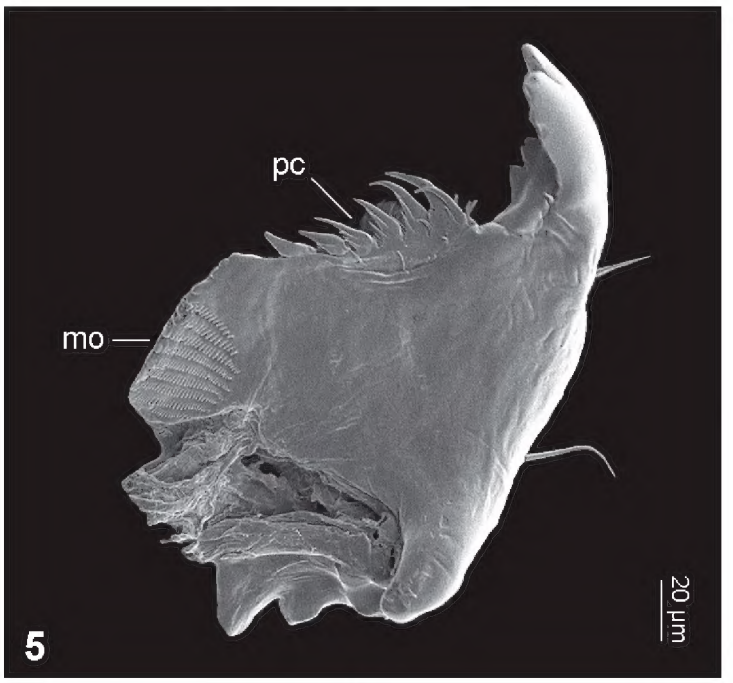
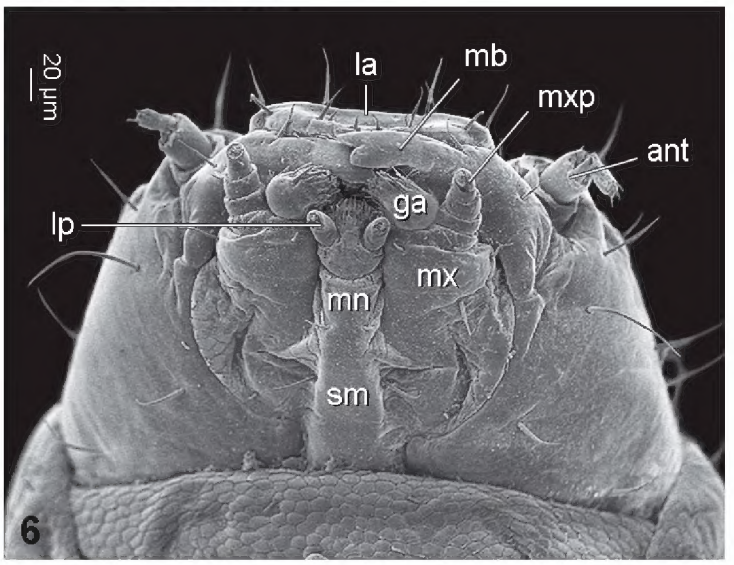


Figure 3. *Omosita nearctica* larva – dorsal (L) and ventral (R) views. hc = head capsule m = mesothorax, mt = metathorax, p = prothorax, pu = pregomphus, sp = spiracle, st = stemmata, u = urogomphus, 1–9 = abdominal tergites. Scale bar: 0.5 mm.





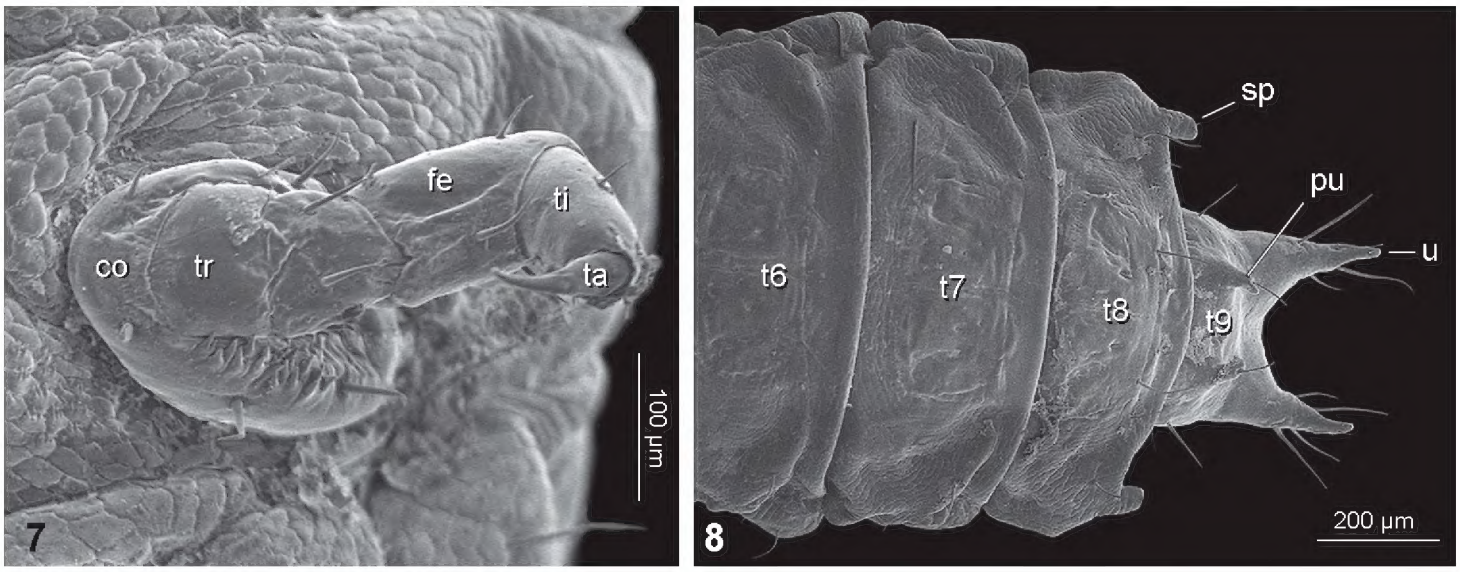


Figures 4–6. 4 SEM dorsal view of head capsule and thorax of *Omosita nearctica* larva. ant = antenna, cly = clypeus, hc = head capsule, m = mesothorax, mt = metathorax, p = prothorax **5** SEM ventral view of left mandible of *Omosita nearctica* larva. mo = mola, pc = prostheca **6** SEM ventral view of head of *Omosita nearctica* larva. ant = antenna, la = labrum, lp = labial palp, mb = mandible, mn = mentum, mx = maxilla, mxp = maxillary palp, sm = submentum. Scale bars: 500 µm (**4**), 20 µm (**5**, **6**).

ezoidal; with three pairs of submarginal setae; clypeal protuberances weak. Clypeolabral suture nearly straight.

Mandible (Fig. 5) apex bidentate; with two subequal lateroventral setae. Prostheca consists of several large lobes; bearing a lightly sclerotized projection at base. Mola transversely ridged. Maxilla elongated. Maxillary palp three-segmented; with third joint longer than first or second. Galea with large, dense apical brush. Lacinia partially fused to galea. Mala enlarged inner-distally; bearing rather sparsely scattered microtrichia. Labium about 1.5 times as long as wide. Labial palp one-segmented; set close at base of labium. Ligula strongly produced. Mentum indistinctly separated from submentum. Submentum with two pairs of setae, one proximal and one distal (Fig. 6).

Thorax (Figs 4, 7). Thoracic tergites (Fig. 4) partially spanning dorsum; medially divided into paratergites. Meso- and metathoracic paraterga small; transversely rectangular; weakly rugose; slightly raised and set close together on mesothorax and touching on metathorax.



Figures 7, 8. 7 SEM of hind leg of *Omosita nearctica* larva. co = coxa, fe = femur, ti = tibia, tr = tarsungulus **8** SEM dorsal view of final segments of the abdomen of *Omosita nearctica* larva. pu = pregomphus, sp = spiracle, u = urogomphus, 6–9 = abdominal tergites. Scale bars: 100 µm (**7**), 200 µm (**8**).

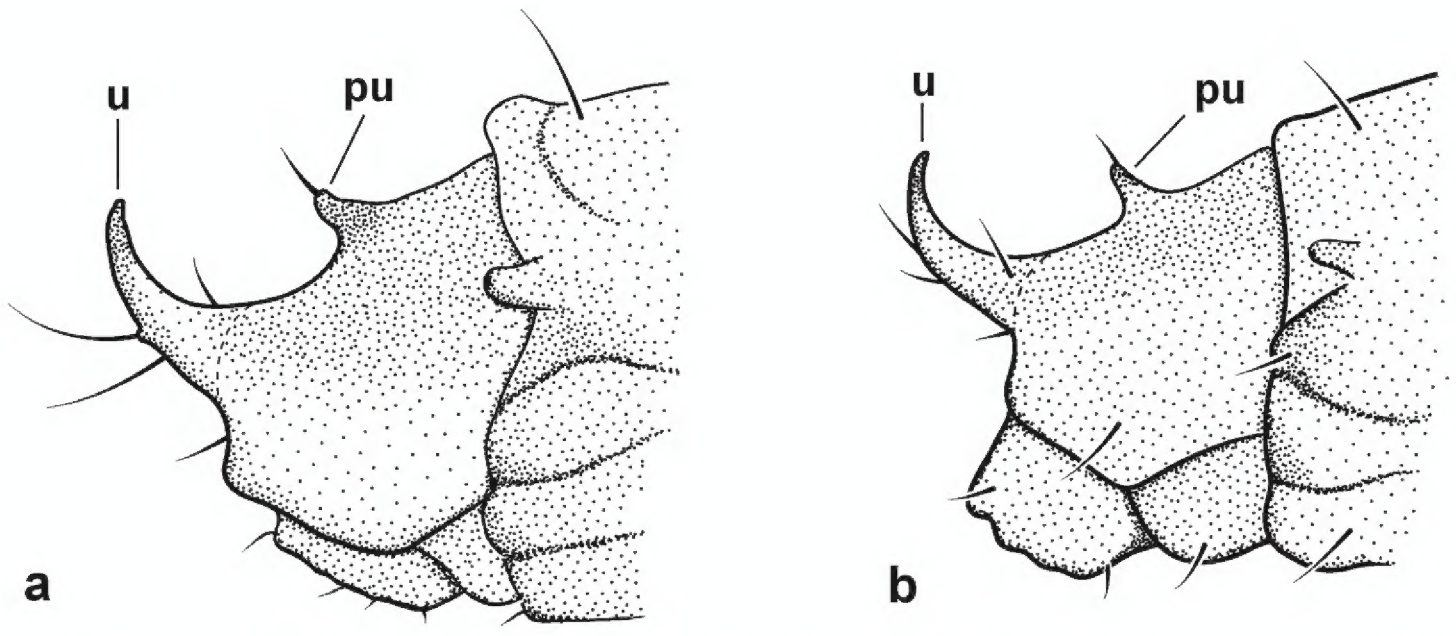


Figure 9. Lateral view of terminal end of *Omosita nearctica* (**a**) and *O. colon* (**b**). pu = pregomphus, u = urogomphus. Not to same scale.

Legs (Fig. 7). Femur 1.5 times longer than wide. Tibia twice as long as wide. Tarsungulus slightly longer than half of tibia; moderately, evenly curved. Forelegs slightly shorter than other legs.

Abdomen (Figs 3, 8, 9). Abdomen about three times as long as thorax (Fig. 3). Abdominal tergites T1-T8 about one fourth as wide as body; medially divided into paratergites. Abdominal paratergites transversely rectangular, weakly rugose, slightly raised, and touching. Pregomphi on ninth tergite, small. Urogomphi (Fig. 8) on ninth tergite unsegmented, half the length of ninth tergum; (viewed dorsally) parallel; (viewed laterally) gradually recurved anteriorly (Fig. 9a). Abdominal spiracles exposed; in posterolateral angles of segment. Spiracular tubes present, longer on segments A7 and, particularly, A8; on A8, as wide as tall. Abdominal sternites unsclerotised; intersternal membranes with shagreened patch along anterior margin.

Discussion

This study presents the first record of *Omosita nearctica* in South Africa and confirms that it is established as a self-sustaining, breeding alien invasive species in the Eastern Cape Province of South Africa. The COI gene (Fig. 2) agreed with the morphological identification of the beetles as *O. nearctica*. The sequence from this study grouped together in a clade with three other sequences of *O. nearctica* that were separated from its sister clade, *O. colon*, with 100% posterior probability (Fig. 2). One sequence (BOLD Public Record COLON045-10.COI-5P) identified as *O. nearctica* grouped unambiguously with the *O. discoidea* clade.

The morphological character states listed in Table 3 may be used to differentiate the mature larva of *O. nearctica* from that of *O. colon*, the only other species of *Omosita* for which the larva has been described (Eichelbaum 1903; Verhoeff 1923; Hinton 1945; Böving and Rozen 1962; Hayashi 1978; Díaz-Aranda et al. 2018). The description of the urogomphi of *O. colon* by Hayashi (1978) differs from the description by Díaz-Aranda et al. (2018). Hayashi (1978) describes them as short and Díaz-Aranda et al. (2018) states they are half the length of the ninth tergite which appears to be more accurate (Fig 9b). It must be noted that the pregomphi and urogomphi are all referred to as urogomphi by Díaz-Aranda et al. (2018). It is crucial to recognise that because *O. nearctica* was recognised only in 1987, prior references to *O. colon* larvae from the Nearctic (e.g. Hinton 1945; Böving and Rozen 1962) may be in error.

The collection of adults in Makhanda in 2001, 2012 and 2013 confirmed that *O. nearctica* has probably established in South Africa. This is important in the global context of this species as it has apparently never been recorded outside North America (GBIF.org 2020). The small size, furtive habits and internationally traded diets of sap beetles in general make them good candidates for transport around the world. For instance, at least 32 extralimital species have established in Europe (Jelínek et al. 2016). Most of these species feed on ripening and decaying fruit, but *O. funesta* was imported from Mexico to Teruel, Spain in 1931, "probably on imported sausages" (Jelínek et al.

Table 3. Character states differentiating the known larvae of *Omosita* species. The character states for *O. colon* were derived from consideration of descriptions by Eichelbaum (1903), Verhoeff (1923), Hayashi (1978), Díaz-Aranda et al. (2018). North American descriptions of larvae of *O. colon* that predate the description of *O. nearctica* (Hinton 1945; Böving and Rozen 1962; Díaz-Aranda et al. 2018) were not used because they may involve unwitting misidentifications.

Character	Character state	
	Omosita nearctica	***Omosita colon***
Head capsule	2.3 times as wide as long (excluding labrum)	1.4 times as wide as long (excluding labrum)
2nd antennomere	with setae, including one directly proximal to sensory area	without setae
Sensory appendix of 2nd antennomere	about two thirds as long as 3rd antennomere	about half as long as 3rd antennomere
Mola	transversely ridged	transversely ridged and asperated
Abdominal paratergites	touching in midline	set fairly close together but not touching in midline
Spiracular tubes on A8	as wide as tall	wider than tall

2016). Species of *Omosita* are generally associated with human middens and animal remains (Hinton 1945; Shubeck et al. 1977; Jelínek 1999; Kočárek 2003; Ewing and Cline 2005; Schlechter 2008; Saloña et al. 2010; Lee et al. 2015; Lyu et al. 2016; Torres et al. 2018), so it is less obvious how they were transported to Africa. *Omosita nearctica* was probably introduced to South Africa on stored products imported through a port or airport. Given the age and remoteness of some austral introductions of *Omosita* (Blackburn 1903; Alfken 1904; Jelínek et al. 2016), it is possible that the population established well before it was discovered.

Their presence in Makhanda (E. Cape, RSA) suggests that they have been in South Africa for many years, since the town has no international airport and the nearest commercial harbours are over 120 km away. The failure to find specimens in Port Alfred (E. Cape, RSA) is ambiguous evidence of the species' distribution because the sampling effort was limited.

Nothing is published about the biology of *O. nearctica* (Kirejtshuk, 1987). That *O. nearctica* larvae feed on cooked sheep bones suggests that this species feeds on saponified oils and decomposing material, like at least some other species in its genus (Lee et al. 2015; Lyu et al. 2016). In China, *O. colon* was the only species of beetle observed breaking down adipocere on corpses, potentially giving that species specific significance in medico-criminal forensic entomology (Lyu et al. 2016). The similar diets and close relationship (Fig. 2) of *O. colon* and *O. nearctica* imply that the latter species may be similarly useful (Midgley et al. 2009). Beetles associated with stored animal products are often relevant to biosecurity. Further studies on the biology of this species should monitor its global spread and determine its usefulness in forensic entomology. The description of the mature larva will assist in identifying this species where only larvae are found associated with stored products, corpses or carcasses.

Acknowledgements

We thank Lyndall Pereira for assistance with DNA extraction and amplification; Burgert Muller for assistance with editing of graphics; Gimo Daniel, Alexander Kirejtshuk, Burgert Muller, one anonymous reviewer and especially Riaan Stals for their valuable comments; and the National Research Foundation (NRF) of South Africa for funding. Any opinion, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Research Foundation. *Omosita nearctica* is neither CITES-listed nor endangered according to regional Red Lists or South Africa's Threatened or Protected Species (ToPS) legislation and thus did not require special sampling permission.

References

Alfken JD (1904) Beitrag zur Insektenfauna der Hawaiischen und Neuseeländischen Inseln (Ergebnisse einer Reise nach dem Pacific, Schauinsland 1896–97). Zoologische Jahrbu-

cher. Abteilung fur Systematik, Geographie und Biologie der Tiere 19: 561–628. [Contribution to the Insect fauna of the Hawaiian Islands and New Zealand, results of a journey to the Pacific, Schauinsland.]

Audisio PA (1990) Notas sobre Nitidulidae ibero-marroquies (Col.). Eos (Madrid) 66: 25–27. [Notes on Iberian and Moroccan Nitidulidae (Col).]

Badenhorst R, Villet MH (2018) The uses of *Chrysomya megacephala* (Fabricius, 1794) (Diptera: Calliphoridae) in forensic entomology. Forensic Science Review 3(1): 2–15. https://doi.org/10.1080/20961790.2018.1426136

Blackburn T (1903) Further notes on Australian Coleoptera, with descriptions of new genera and species, xxxiii. Transactions and Proceedings and Report of the Royal Society of South Australia 27: 261–309.

Böving A, Rozen J (1962) Anatomical and systematic study of the mature larvae of the Nitidulidae (Coleoptera). Ent. Medd., Copenhagen 31: 265–299.

Carlton C, Leschen A (2007) Descriptions of *Soronia* complex (Nitidulidae: Nitidulinae) larvae of New Zealand with comments on life history and taxonomy. New Zealand Entomologist 30(1): 41–51. https://doi.org/10.1080/00779962.2007.9722150

de Vylder G (1998) The journal of Gustav de Vylder, naturalist in South-West Africa (translated by I. & J. Rudner). Van Riebeeck Society 28.

Díaz-Aranda LM, Martín-Vega D, Baz A, Cifrián B (2018) Larval identification key to necrophagous Coleoptera of medico-legal importance in the western Palaearctic. International Journal of Legal Medicine 132(6): 1795–1804. https://doi.org/10.1007/s00414-018-1909-2

Eichelbaum F (1903) Larve und Puppe von *Omosita colon* L. Allgemeine Zeitschrift für Entomologie 8: 81–87.

Emberson RM (1998) The beetle (Coleoptera) fauna of the Chatham Islands. New Zealand Entomologist 21(1): 25–64. https://doi.org/10.1080/00779962.1998.9722037

Ewing CP, Cline AR (2005) Key to adventive sap beetles (Coleoptera: Nitidulidae) in Hawaii, with notes on records and habits. Coleopterists Bulletin 59(2): 167–183. https://doi.org/10.1649/736

Gess DS, Ranwashe F (2017) AM: Terrestrial Insect Collections (1896–2000). Version 1.5. https://doi.org/10.15468/nlkj0p

Hayashi N (1978) A contribution to the knowledge of the larvae of Nitidulidae occurring in Japan (Coleoptera : Cucujoidea). Insecta Matsumurana 14: 1–97. [New Series]

Hinton HE (1945) A monograph of the beetles associated with stored products (Vol. I). British Museum (Natural History), London, 443 pp.

Huelsenbeck JP, Ronquist F (2001) MRBAYES: Bayesian inference of phylogenetic trees. Bioinformatics (Oxford, England) 17(8): 754–755. https://doi.org/10.1093/bioinformatics/17.8.754

Jelínek J (1999) Contribution to taxonomy of the beetle subfamily Nitidulinae (Coleoptera: Nitidulidae). Folia Heyrovskyana 7: 251–281.

Jelínek J, Audisio P, Hájek J, Baviera C, Moncoutier B, Barnouin T, Brustel H, Genç H, Leschen RAB (2016) *Epuraea imperialis* (Reitter, 1877). New invasive species of Nitidulidae (Coleoptera) in Europe, with a checklist of sap beetles introduced to Europe and Mediterranean areas. Atti della Accademia Peloritana dei Pericolanti, Classe di Scienze Fisiche, Matematiche e Naturali 94: A4-1-A4-24. https://doi.org/10.1478/AAPP.942A4

Kirejtshuk AG (1987) Новые таксоны жуков-блестянок (Coleoptera, Nitidulidae) Восточного полушария (часть 1). *Omosita nearctica* sp.n., викарирующий с палеарктическим *O. colon* (L.). Труды Зоологического института АН СССР 164: 63–94.[New taxa of the sap beetles (Coleoptera, Nitidulidae) of the East Hemisphere Part 1. *Omosita nearctica* sp. n., vicariant of Palaearctic *O. colon* (L). Proceedings of the Zoological Institute Academy of Sciences of the USSR]

Kirejtshuk AG (2001) Notes on the systematics of the African Nitidulidae (Coleoptera). Annales Historico-Naturales Musei Nationalis Hungarici 93: 17–89.

Kočárek P (2003) Decomposition and Coleoptera succession on exposed carrion of small mammal in Opava, the Czech Republic. European Journal of Soil Biology 39(1): 31–45. https://doi.org/10.1016/S1164-5563(02)00007-9

Lee S, Kirejtshuk A, Lee S (2015) Review of the genus *Omosita* Erichson (Coleoptera: Nitidulidae: Nitidulinae) in Korean fauna, with key to the Palaearctic species. Journal of Asia-Pacific Entomology 18(4): 837–834. https://doi.org/10.1016/j.aspen.2015.10.009

Lee MH, Lee S, Leschen RAB, Lee S (2020) Evolution of feeding habits of sap beetles (Coleoptera: Nitidulidae) and placement of Calonecrinae. Systematic Entomology 45: 911–923. https://doi.org/10.1111/syen.12441

Lyu Z, Wan L, Yang Y, Tang R, Xu L (2016) A checklist of beetles (Insecta, Coleoptera) on pig carcasses in the suburban area of southwestern China: A preliminary study and its forensic relevance. Journal of Forensic and Legal Medicine 41: 42–48. https://doi.org/10.1016/j.jflm.2016.04.009

Midgley JM, Richards CS, Villet MH (2009) The Utility of Coleoptera in Forensic Investigations. In: Amendt J, Campobasso CP, Goff ML, Grassberger M (Eds) Current Concepts in Forensic Entomology. Springer Netherlands, Dordrecht, 57–68. https://doi.org/10.1007/978-1-4020-9684-6_4

Mroczkowski M (1968) Distribution of the Dermestidae (Coleoptera) of the world with a catalogue of all known species. Annales Zoologici Warszawa 26: 15–191.

Posada D (2008) jModelTest: Phylogenetic model averaging. Molecular Biology and Evolution 25(7): 1253–1256. https://doi.org/10.1093/molbev/msn083

Reitter E (1873) Systematische Eintheilung der Nitidularein. Verhandlungen des naturforschenden Vereines in Brünn 12: 4–194.

Reitter E (1874) Beschreibungen neuer Käfer-Arten nebst synonymischen Notizen. Zool.-Bot. Ges. Österreich 24: 509–528.

Saloña MI, Moraza ML, Carles-Tolrá M, Iraola V, Bahillo P, Yélamos T, Outerelo R, Alcaraz R (2010) Searching the soil: forensic importance of edaphic fauna after the removal of a corpse. Journal of Forensic Sciences 55(6): 1652–1655. https://doi.org/10.1111/j.1556-4029.2010.01506.x

Schlechter J (2008) Beetle fauna found on carrion in three woodland sites in Luxembourg (Insecta, Coleoptera). Bulletin de la Societe des Naturalistes Luxembourgeois 109: 97–100.

Shubeck PP, Downie NM, Wenzel RL (1977) Species composition of carrion beetles in a mixed-oak forest. Memorial Forest Bulletin 1975: 12–17.

Torres HH, Martínez OG, García IS, Uribe LAA, Peña RSR (2018) Primer registro de *Omosita colon* (Linnaeus) (Coleoptera: Nitidulidae: Nitidulinae) recolectada en cadáveres de cabrito (*Capra aegagrus hircus* Linnaeus) en Buenavista, Saltillo Coahuila, México. Insecta Mundi 0626: 1–5.

Verhoeff KW (1923) Beitrage zur Kenntnis der Coleopteren-Larven mit besonderer Beriicksichtigung der Clavicornia. Arch. Natg. Berlin Abt 89: 1–109.

Villet MH, Clitheroe C, Williams KA (2017) The temporal occurrence of flesh flies (Diptera, Sarcophagidae) at carrion-baited traps in Grahamstown, South Africa. African Invertebrates 58(1): 1–8. https://doi.org/10.3897/AfrInvertebr.58.9537

Williams KA, Villet MH (2006) A new and earlier record of *Chrysomya megacephala* in South Africa, with notes on another exotic species, *Calliphora vicina* (Diptera: Calliphoridae). African Invertebrates 47: 347–350.

Williams KA, Villet MH (2019) Spatial and seasonal distribution of forensically important blow flies (Diptera: Calliphoridae) in Makhanda, Eastern Cape, South Africa. Journal of Medical Entomology 1–8. https://doi.org/10.1093/jme/tjz056

Appendix 1

Key to adults of the species of the genus *Omosita* (based on diagnostic character states proposed by Reitter 1873, 1874; Kirejtshuk 1987; Jelínek 1999 and Lee et al 2015).

1 Pronotum with convex median area not demarcated from explanate lateral margins by grooves **2**

– Pronotum with convex median area demarcated from explanate lateral margins by roughly parallel, arcuate grooves **5**

2(1) Antennal club elongate-oval, distinctly longer than wide **3**

– Antennal club rounded or subtriangular, not longer than wide **4**

3(2) Elytra 1.5 times longer than their combined width. Pronotum narrowly explanate laterally; anterior margin shallowly, arcuately notched. Antennal club not constricted in middle ..... ***Omosita funesta***

– Elytra at most 1.3 times longer than their combined width. Pronotum widely explanate laterally; anterior margin deeply notched; Antennal club constricted in middle ..... ***Omosita discoidea***

4(2) Antennal club rounded, about as long as wide. Mentum without distinct sulcus along posterior border ..... ***Omosita nearctica***

– Antennal club broad or subquadrangular to obovate to trapezoidal or subtriangular, usually shorter than wide. Mentum with distinct transverse sulcus along posterior border ..... ***Omosita japonica***

5(1) Grooves between convex median area of pronotum and its explanate margins indistinct ..... ***Omosita colon***

– Grooves between convex median area of pronotum and its explanate margins distinct **6**

6(5) Pronotum narrowly explanate laterally. Antennal club not constricted in middle. Postmentum with lateral margins raised and sharp; its punctation rugose ..... ***Omosita smetanai***

– Pronotum widely explanate laterally. Antennal club constricted in middle. Postmentum with lateral edges margins; its punctation simple and widely spaced ..... ***Omosita depressa***